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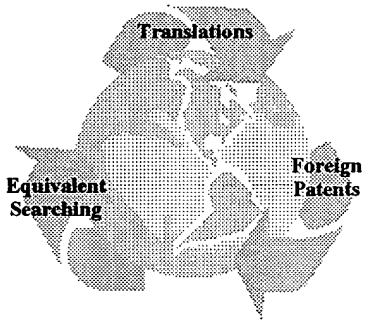

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PUB-NO: JP404262017A
DOCUMENT-IDENTIFIER: JP 04262017 A
TITLE: EXHAUST MANIFOLD FOR ENGINE EQUIPPED WITH SUPERCHARGER

PUBN-DATE: September 17, 1992

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TOYOTA MOTOR CORP

APPL-NO: JP03023608
APPL-DATE: February 18, 1991

INT-CL (IPC): F01N 7/08; F02B 37/00; F02B 37/02

ABSTRACT:

PURPOSE: To improve the reliability in durability by preventing the thermal deterioration of a flexible pipe due to exhaust gas.

CONSTITUTION: An exhaust manifold 8 is equipped with the first exhaust manifold constitution body 51, second exhaust manifold constitution body 52, and a flexible pipe 56 which connects the first and second exhaust manifold constitution bodies 51 and 52 and is elastically deformable. The first exhaust manifold constitution body 51 is installed between the first cylinder group A of an engine 1 and a main turbocharger 10, and the second exhaust manifold constitution body 52 is installed between the second cylinder group B of the engine 1 and a subturbocharger 11. Further, the flexible pipe 56 is arranged at the position deflecting to the subturbocharger 11 side from the center C between both the exhaust manifold constitution bodies 51 and 52.

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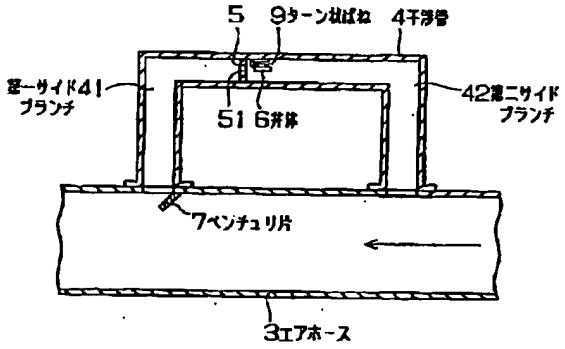
(54)【発明の名称】 消音装置

(57)【要約】
【目的】 消音周波数範囲を広げることができ、そのための構造も簡単かつ小型になり、コストアップを抑えることもできる消音装置を提供する。
【構成】 流気管路３に両端が連通する干渉管４が設けられた干渉型の消音装置において、前記干渉管４の一端又は両端の開口部には該干渉管４の両端間に気圧差を発生させる気圧調整手段７を設け、該干渉管４の途中部には前記気圧差により変位して該途中部を開閉する弁体６を設けるとともに、該弁体６の変位を復帰させるばね９を設けた。



PTO 03-3336

Japanese Kokai Patent Application
No. Hei 4[1992]-259617

MUFFLING DEVICE

Kazuo Fujihara et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
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MUFFLING DEVICE

[Shoon sochi]

Inventors:	000241463 Kazuo Fujihara et al.
Applicant:	Toyota Gosei K.K.

[There are no amendments to this patent.]

Claim

A type of muffling device characterized by the following facts: it is an interference type muffling device, with an interference pipe set connected to two ends of a gas flow pipeline; in this muffling device, a gas pressure adjusting means that generates a gas pressure difference between the two ends of the interference pipe is set on the opening portion at one end of both ends of said interference pipe; a valve body is set at a halfway portion on the interference pipe, and it makes displacement to turn said halfway portion due to said gas pressure difference, and a spring for resetting the displaced valve body is set.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to a type of muffling device for suppressing noise generated in a gas flow pipeline. In particular, this invention pertains to a type of muffling device with a structure for expanding the muffling frequency range.

[0002]

Prior art

The frequency of noise generated in a gas flow pipeline varies as a function of various conditions. For example, the frequency of the air intake noise generated in the air intake pipeline or the gas exhausting noise generated in the gas exhausting pipeline of an internal combustion engine varies almost proportionally to the rotating velocity of the internal combustion engine. In order to suppress said varying noises, it is necessary to install a muffling device with a wide muffling frequency range in the gas flow pipeline. Various methods may be adopted to expand the muffling frequency range of the muffling device depending on the specific muffling mechanism. For example, the following types of muffling device may be used.

[0003]

Japanese Kokai Utility Model Application No. Sho 60[1985]-23245 described a resonating type muffling device (first prior art) characterized by the following facts: the opening area of the through-hole that connects the air intake pipeline and the resonant muffling chamber can be changed by means of a sliding cylinder; by controlling the sliding cylinder with an F/V converter that detects the rotating velocity of the internal combustion engine and a potentiometer connected to it, it is possible to change the area of the opening corresponding to the aforementioned rotating velocity.

[0004]

Japanese Kokai Utility Model Application No. Sho 59[1984]-39760 described a resonating type muffling device (second prior art) characterized by the following facts: the opening area of a resonant hole connected to the pipeline and a resonant muffling chamber can be changed by means of a sliding valve; by driving the sliding valve with bellows or the like that functions due to the negative pressure of the resonant muffling chamber, said opening area is changed proportionally to said negative pressure.

[0005]

Japanese Kokai Utility Model Application No. Sho 61[1986]-202617 described a resonating type muffling device (third prior art) characterized by the following facts: the cross-sectional area of a connecting pipe that connects a gas flow pipeline and a resonant muffling chamber by means of a bellows or the like; by stretching the bellows by means of the back pressure in the connecting pipe, is it possible to change said cross-sectional area corresponding to said back pressure.

[0006]

Japanese Kokai Utility Model Application No. Sho 59[1984]-41664 described a resonating type muffling device (fourth prior art) characterized by the following facts: the volume of a resonant muffling chamber connected to the air intake pipeline is changed by means of a bellows; and by stretching the bellows by means of the air intake negative pressure, it is possible to change said volume corresponding to said air intake negative pressure.

[0007]

Problems to be solved by the invention

However, for the aforementioned first prior art, it is necessary to have an F/V converter and other controllers as well as a potentiometer and other actuators, the structure becomes complicated, the cost becomes higher, and this is undesirable.

[0008]

For said second through four prior arts, although the structure is not so complicated as that of the first prior art, it is nevertheless necessary to use bellows with a large stretching area, a large spring for resetting after stretching, etc. Consequently, the structure becomes complicated, the size becomes larger, and the cost becomes higher. This is undesirable.

[0009]

The purpose of this invention is to solve the aforementioned problems of the prior art by providing a type of muffling device characterized by the fact that it not only can expand the muffling frequency range, but also it has a simple and small structure and avoids increasing the cost.

[0010]

Means to solve the problem

In order to realize the aforementioned purpose, this invention provides a type of muffling device characterized by the following facts: it is an interference type muffling device, with an interference pipe set connected to both ends of a gas flow pipeline; in this muffling device, a gas pressure adjusting means that generates a gas pressure differential between the two ends of the interference pipe is set on the opening portion at one end of both ends of said interference pipe; a valve body is set halfway on the interference pipe, and it makes displacement to turn said halfway portion due to said gas pressure differential, and a spring for resetting the displaced valve body is also installed.

[0011]

Here, there is no special limitation on the "gas flow pipeline". Any type that allows flowing of gas can be used, such as the air intake pipeline or gas exhaust pipeline of internal combustion engines. Also, there is no special limitation on the shape and dimensions of the "interference pipe", as long as the difference between its effective length and the length of the corresponding portion of said gas flow pipeline is half the wavelength of the desired muffling frequency.

[0012]

Also, as "gas pressure adjusting means", one may adopt a Venturi structure that can augment the negative pressure in the opening portion of the interference pipe, or a flowing gas intake structure that takes the gas flowing in the gas flow pipeline from one end of the interference pipe. Also, examples of the "valve body" are as follows: ① A type of valve body, which has one end attached on the inner wall of the interference pipe such that tilting can be performed and is in contact with a valve base set halfway of the interference pipe. ② A type of valve body which can make displacement when it is set parallel and facing said valve seat. Also, there is no special limitation on the type of the "spring", as long as it has a function for resetting displacement of the valve body.

[0013]

Operation

First of all, when the flow velocity of the gas flowing in the gas flow pipeline is low, the frequency of the noise generated in the gas flow pipeline is usually low, and the difference in gas pressure between the two ends of the interference pipe due to the gas pressure adjusting means is also smaller. In this case, ① when the valve body is set such that it opens the halfway portion of

the interference pipe, the intrinsic interference function of the interference pipe can be displayed, and the muffling frequency due to this interference matches the frequency of said noise. ② When the valve body is set such that it closes the halfway portion of the interference pipe, the interference pipe displays a resonant function as two side branches, and the muffling frequency due to their resonance matches the frequency of the noise.

[0014]

On the other hand, when the flow velocity of the gas flowing in the gas flow pipeline is high, the frequency of the noise generated in the gas flow pipeline is usually high, and the difference in the gas pressure generated between the two ends of the interference pipe due to the gas pressure adjusting means also becomes larger. In this case, ① when the valve body is set such that it closes the halfway portion of the interference pipe, the interference pipe displays a resonant function as two side branches, and the muffling frequency due to their resonance reaches the frequency of the noise. On the other hand, ② when the valve body is set such that it opens the halfway portion of the interference pipe, the intrinsic interference function of the interference pipe can be displayed, and the muffling frequency due to this interference matches the frequency of said noise.

[0015]

In this way, by switching the muffling function using the interference pipe, the muffling frequency can be made in agreement with the frequency of the noise. As a result, the range of the muffling frequency can be effectively expanded. Also, the structure for expanding the muffling frequency range is composed merely of said gas pressure adjusting means, valve body, and spring. It is simple and small in size, and has only a few parts.

[0016]

Application examples

In the following, the first application example of the resonating type muffling device set on the air intake pipeline of an internal combustion engine will be explained in detail with reference to Figures 1-5. Interference pipe (4) that connects to the two ends of air hose (3) is set outside air hose (3) as an air intake pipeline that connects between air cleaner (1) and fuel injecting device (2) of the internal combustion engine. Suppose the effective length between the two ends of said interference pipe (4) is L1, and the straight line distance between the opening portions at the two ends of interference pipe (4), that is, the corresponding length of the air hose with respect to interference pipe (4), is L2, interference effect takes place at the frequency with

its half wavelength corresponding to L1-L2. Consequently, muffling frequency f0, that is, the frequency of interference, becomes the following Numerical Formula 1.

[0017]
[Numerical formula 1]
$F0 = C/[2(L1-L2)]$
where, $C = 331.5+0.61t$: sonic velocity (m/sec)
t: temperature (°C)

[0018]

Frequency fi of the air intake noise generated in air hose (3) increases as it is nearly proportional to the rotating velocity of the internal combustion engine. Because said L1 and L2 are constant, it is difficult to change muffling frequency f0. However, when the rotating velocity of the internal combustion engine rises, if interference pipe (4) can be turned OFF halfway, for said interference pipe (4), resonance takes place as first side branch (4a) and second side branch (4b) connected to air hose (3) independently on the left/right sides, respectively. Consequently, suppose said two side branches (4a), (4b) have lengths L3 and L4, respectively, muffling frequency f0 becomes two muffling frequencies f01 and f02 of said side branches (4a), (4b) defined in following Numerical Formula 2. Consequently, by selecting L3 and L4 appropriately, it is possible to match one of muffling frequencies f01 and f02 to air intake frequency fi.

[0019]
[Numerical formula 2]
$F01 = (2n-1)C/4L3$
$F02 = (2n-1)C/4L4$
where, n=1, 2...

[0020]

In this application example, valve seat (5) having through-hole (51) formed on it is set in a halfway portion of interference pipe (4). Also, plate-shape valve body (6) is set with the following function: When the difference in gas pressure between the two ends of interference pipe (4) becomes smaller, it pops up so that through-hole (51) of said valve seat (5) is opened. When the difference in gas pressure between the two ends of interference pipe (4) becomes larger, it tilts downward to close through-hole (51) on said valve seat. On the inner wall of interference pipe (4) on the immediate upstream side of said valve seat (5), turn-shape spring (9) prepared by winding an elastic metal wire in one or several small turns and having its two ends

extending parallel to each other has one end fixed, and the other end of said turn-shape spring (9) is fixed on the back side of said valve body (6). Consequently, said valve body (6) is supported by said turn-shape spring (9) such that it can tilt around its winding portion, and it can recover after tilting.

[0021]

Also, on the upstream edge of the left-end opening portion of interference pipe (4), Venturi structure (7) is set as a gas pressure adjusting means extending obliquely towards the downstream side and the center of air hose (3). By means of this Venturi structure (7), the negative pressure of the opening portion on the left end of interference pipe (4) is higher than that of the opening portion on the right end, and a difference in gas pressure between the two ends of interference pipe (4) is generated. When the rotating velocity of the internal combustion engine is increased, the gas pressure in air hose (3) decreases, and the negative pressure becomes stronger. As a result, the difference in gas pressure between the two ends of said interference pipe (4) also becomes larger. As explained in the above, valve body (6) makes displacement to close through-hole (51).

[0022]

In the following, an explanation will be given for the functions and effects of the muffling device with the aforementioned constitution. First of all, when the rotating velocity of the internal combustion engine is decreased, air intake noise frequency fi also decreases. In this case, the negative pressure in air hose (3) becomes weaker, and the difference in gas pressure between the two ends of interference pipe (4) becomes smaller. Consequently, as shown in Figures 1 and 2, valve body (6) pops up and creaks a tilt, so that through-hole (51) is left opened. Consequently, the intrinsic interference function of interference pipe (4) works, and muffling frequency f0 defined by said Numerical Formula 1 matches air intake noise frequency fi. Of course, the precondition for this is that effective length L1 of said interference pipe (4) and corresponding length L2 of air hose (3) are selected appropriately. This selection can be performed easily using said Numerical Formula 1.

[0023]

When the rotating velocity of the internal combustion engine is increased, air intake noise frequency fi also increases. In this case, the negative pressure in air hose (3) becomes stronger, and at the same time, due to Venturi structure (7), the negative pressure on the left end of interference pipe (4) becomes greater than that on the right end, and the difference in gas pressure between the two ends becomes larger. As shown in Figure 3, valve body (6) tilts

downward and contacts valve seat (5) to close through-hole (51). As a result, interference pipe (4) is divided into two side branches (41) and (42) on the left/right sides, and they resonate independently. Said muffling frequency f0 is switched to muffling frequencies f01 and f02 defined in said Numerical Formula 2. Consequently, one of these frequencies in agreement with air intake noise frequency fi. Of course, the precondition for this agreement is that lengths L3 and L4 of two side branches (41), (42) are selected appropriately. This selection can be performed easily using said Numerical Formula 2.

[0024]

However, air intake noise frequency fi of an internal combustion engine is usually not a single frequency. Instead, it is usually composed of a peak-level frequency component fi1 and another frequency component fi2. In this application example, muffling frequency f01 corresponding to first side branch (41) matches peak-level frequency component fi1, and muffling frequency f02 of second side branch (42) matches the other frequency component fi2, so that the muffling effect can be further improved.

[0025]

Consequently, for the muffling device of this invention, by switching the muffling function by means of interference pipe (4) to make muffling frequency f0 in agreement with air intake noise frequency fi, it is possible to effectively expand the muffling frequency range. Also, the structure for expanding the muffling frequency range is composed only of said Venturi structure (7), valve body (6) and turn-shape spring (9). It is simple, small in size, and is composed of a few parts. Consequently, compared with the conventional muffling device of this type, the muffling device of this invention has a simpler structure and a lower cost.

[0026]

In the following, an explanation will be given for the muffling device in the second application example of this invention with reference to Figures 6-8. This second application example differs from said first application example with respect to the following features: ① coil spring (12) is installed between spring end supporting unit (11) set on the downstream side of valve seat (5) and the back side of valve body (6), and valve body (6) can make displacement while it faces and parallel to valve seat (5); ② on the downstream side edge and the opening portion on the right end of interference pipe (4), air-intake [valve] (8) is set as a gas pressure adjusting means extending obliquely towards the center of air hose (3) from the upstream side; and [3] when the difference in gas pressure between the two ends of interference pipe (4) is small, valve body (6) makes contact with valve seat (5) to close through-hole (51); and, when the

difference in gas pressure between the two ends of interference pipe (4) becomes larger, valve body (6) leaves valve seat (5) to open through-hole (51). Said air-intake (8) picks up a portion of the intake air flowing in air hose (3) from the right end of interference pipe (4), so that the gas pressure on the right end becomes higher than that on the left end. As a result, a gas pressure differential is generated between the two ends.

[0027]

In this second application example, as shown in Figures 6 and 7, when the rotating velocity of the internal combustion engine is low, valve body (6) is in contact with valve seat (5) to close through-hole (51). Consequently, interference pipe (4) is divided to first side branch (41) and second side branch (42), which resonate independently. Consequently, muffling frequency f0 becomes muffling frequencies f01 and f02 defined by said Numerical Formula 2. Consequently, by selecting L3 and L4 appropriately, it is possible to have one of said muffling frequencies f01 and f02 match air intake noise frequency fi. Also, as the rotating velocity of the internal combustion engine is increased, as shown in Figure 8, the difference in gas pressure between the two ends of interference pipe (4) becomes larger, and valve body (6) moves against the elastic force of coil spring (12) and leaves valve seat to open through-hole (51). Consequently, the intrinsic interference function of interference pipe (4) functions, and muffling frequency f0 is switched to the frequency defined in said Numerical Formula 1. Consequently, by selecting L1 and L2 appropriately, it is possible to have muffling frequency f0 match air intake noise frequency fi. Consequently, the same effects as those in the first application example can be displayed in this second application example.

[0028]

This invention is not limited to the constitution of said application examples. Modifications can be made as long as the gist of this invention is observed.

[0029]

Effect of the invention

For the muffling device of this invention with the aforementioned constitution, it is possible to expand the muffling frequency range, and as the structure for this purpose is simple and small in size, it is possible to decrease the cost. This is the excellent effect of this invention.

Brief description of the figures

Figure 1 is a cross-sectional view illustrating the state in which the halfway portion of the interference pipe is opened in the first application example.

Figure 2 is a cross-sectional view illustrating the main portion of Figure 1.

Figure 3 is a cross-sectional view illustrating the main portion in the state in which the halfway portion of the interference pipe is closed in the first application example.

Figure 4 is a side view of the main portion of Figure 3 as seen from the right side.

Figure 5 is a front view illustrating the state of installation in the first application example.

Figure 6 is a cross-sectional view illustrating the state in which the halfway portion of the interference pipe in closed in the second application example.

Figure 7 is a cross-sectional view of the main portion of Figure 6.

Figure 8 is a cross-sectional view of the main portion of the state in which the halfway portion of the interference pipe is opened in the second application example.

Brief description of the part numbers

3 Air hose as gas flow pipeline
4 Interference pipe
6 Valve body
7 Venturi structure as gas pressure adjusting means
8 Air-intake [valve] as a gas pressure adjusting means
9 Turn-shape spring
12 Coil spring
41 First side branch
42 Second side branch

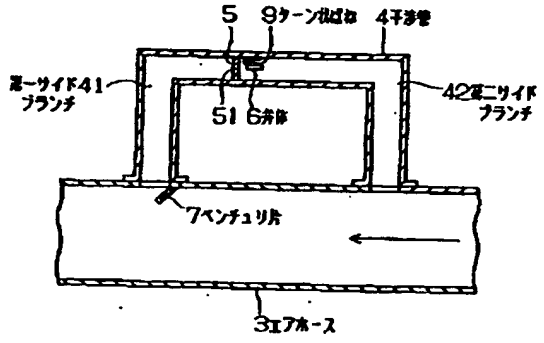

Figure 1

Key: 3 Air hose
4 Interference pipe
6 Valve body
7 Venturi structure

9 Turn-shape spring
41 First side branch
42 Second side branch

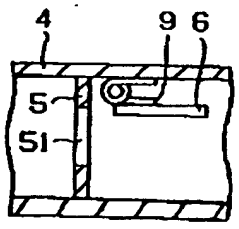

Figure 2

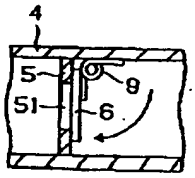

Figure 3

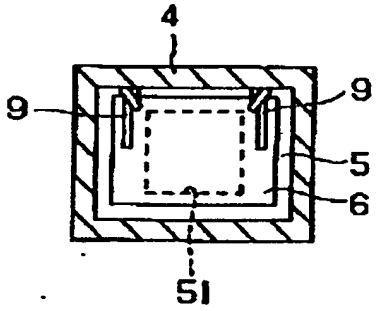

Figure 4

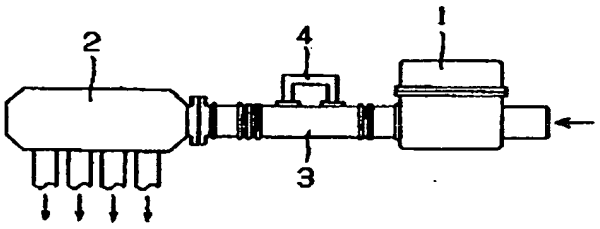

Figure 5

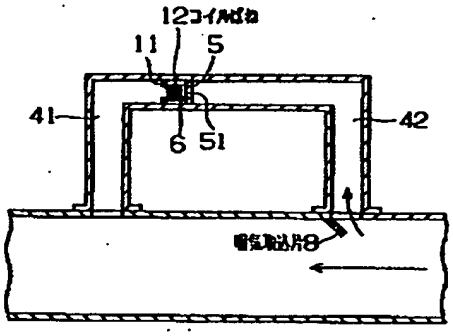

Figure 6

Key: 8 Air-intake [valve]
12 Coil spring

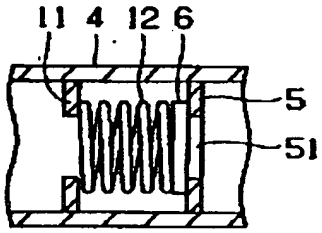

Figure 7

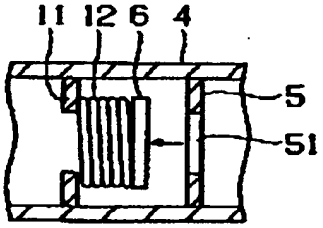

Figure 8

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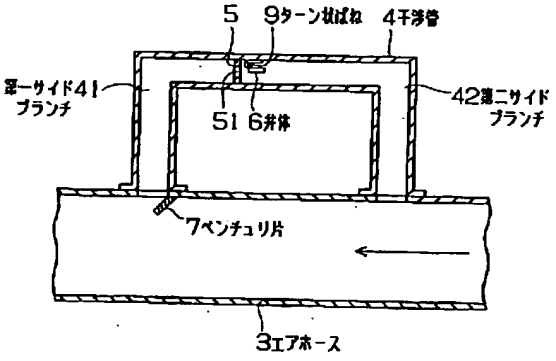
(54)【発明の名称】　消音装置

(57)【要約】
【目的】　消音周波数範囲を広げることができ、そのための構造も簡単かつ小型になり、コストアップを抑えることもできる消音装置を提供する。
【構成】　流気管路３に両端が連通する干渉管４が設けられた干渉型の消音装置において、前記干渉管４の一端又は両端の開口部には該干渉管４の両端間に気圧差を発生させる気圧調整手段７を設け、該干渉管４の途中部には前記気圧差により変位して該途中部を開閉する弁体６を設けるとともに、該弁体６の変位を復帰させるばね９を設けた。



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【特許請求の範囲】

【請求項1】　流気管路に両端が連通する干渉管が設けられた干渉型の消音装置において、前記干渉管の一端又は両端の開口部には該干渉管の両端間に気圧差を発生させる気圧調整手段を設け、干渉管の途中部には前記気圧差により変位して該途中部を開閉する弁体を設けるとともに、該弁体の変位を復帰させるばねを設けたことを特徴とする消音装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、流気管路に発生する騒音を消すための消音装置に関し、特に消音周波数範囲を広げる構造を備えた消音装置に係るものである。

【0002】

【従来の技術】流気管路に発生する騒音の周波数は、種々の条件により変化することがある。例えば、内燃機関の吸気管路に発生する吸気音又は排気管路に発生する排気音の周波数は、内燃機関の回転数に略比例して刻々と変化する。このように変化する騒音を常に低く抑えるには、前記流気管路に消音周波数範囲の広い消音装置を設ける必要がある。消音装置の消音周波数範囲を広げるには、その消音機構によって色々な方法があり、例えば次のような消音装置が知られている。

【0003】実開昭60－23245号公報には、吸気管路と共鳴消音室とを連通する透孔の開口面積をスライドシリンダにより可変とし、該スライドシリンダを内燃機関の回転数を検出するF／Vコンバータとこれに接続されたポテンショメータとで駆動することにより、前記開口面積を前記回転数に応じて変化させるようにした共鳴型の消音装置が示されている（第一従来例）。

【0004】実開昭59－39760号公報には、管路と共鳴消音室とを連通する共鳴孔の開口面積をスライド弁により可変とし、該スライド弁を共鳴消音室の負圧により作動するベローズ等で駆動することにより、前記開口面積を前記負圧に比例して変化させるようにした共鳴型の消音装置が示されている（第二従来例）。

【0005】実開昭61－202617号公報には、流気管路と共鳴消音室とを連通する連通管の断面積をベローズにより可変とし、該ベローズを連通管内の背圧により伸縮させることにより、前記断面積を前記背圧に応じて変化させるようにした共鳴型の消音装置が示されている（第三従来例）。

【0006】実開昭59－41664号公報には、吸気管路に連通する共鳴消音室の容積をベローズにより可変とし、該ベローズを吸気負圧により伸縮させることにより、前記容積を前記吸気負圧に応じて変化させるようにした共鳴型の消音装置が示されている（第四従来例）。

【0007】

【発明が解決しようとする課題】ところが、上記の第一従来例においては、F／Vコンバータ等の制御装置や、

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ポテンショメータ等のアクチュエータが必要なので、構造が複雑になり、コストも大きくアップするという問題があった。

【0008】また、上記の第二～第四従来例においては、第一従来例ほどではないけれども、伸縮量の大きなベローズやその伸長復帰用の大きなスプリング等が必要なので、構造が複雑かつ大型になり、コストもアップするという問題があった。

【0009】本発明の目的は、上記課題を解決し、消音周波数範囲を広げることができるだけでなく、そのための構造が簡単かつ小型になり、コストアップを抑えることもできる消音装置を提供することにある。

【0010】

【課題を解決するための手段】上記目的を達成するために、本発明の消音装置は、流気管路に両端が連通する干渉管が設けられた干渉型の消音装置において、前記干渉管の一端又は両端の開口部には該干渉管の両端間に気圧差を発生させる気圧調整手段を設け、干渉管の途中部には前記気圧差により変位して該途中部を開閉する弁体を設けるとともに、該弁体の変位を復帰させるばねを設けたことを特徴とする。

【0011】ここで、「流気管路」は気体が流れる管路であれば特定のものに限定されず、例えば内燃機関の吸気管路又は排気管路を挙げることができる。また、「干渉管」は、その実効長さと前記流気管路の対応部分の長さとの差が所望の消音周波数の波長の半分になるように設定されたものであればよく、特定の形状又は寸法には限定されない。

【0012】また、「気圧調整手段」としては、干渉管の開口部の負圧を強めるベンチュリ構造や、流気管路内を流れる流気を干渉管の一端から取り込んむ流気取込構造等を例示することができる。また、「弁体」としては、①その一端において干渉管の内壁に傾動可能に取り付けられ、干渉管の途中部に設けられた弁座に当接するようにした弁体や、②前記弁座に対して平行に対峙しながら変位するようにした弁体等を例示することができる。また、「ばね」は弁体の変位を復帰させる機能を有するものであればよく、特定の種類のばねに限定されない。

【0013】

【作用】まず、流気管路内を流れる気体の流速が低いとき、該流気管路に発生する騒音の周波数は一般に低くなり、気圧調整手段によって干渉管の両端間に発生する気圧差も小さくなる。このとき、①弁体が干渉管の途中部を開くように設定されている場合には、干渉管は本来の干渉作用を奏し、その干渉による消音周波数は前記騒音の周波数に一致する。②また、弁体が干渉管の途中部を閉じるように設定されている場合には、干渉管は2本のサイドブランチとして共鳴作用を奏し、その共鳴による消音周波数は前記騒音の周波数に一致する。

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【0014】次に、流気管路内を流れる気体の流速が高いとき、該流気管路に発生する騒音の周波数も一般に高くなり、気圧調整手段によって干渉管の両端間に発生する気圧差も大きくなる。このとき、上記①の弁体は干渉管の途中部を閉じるため、干渉管は2本のサイドブランチに切り換わって共鳴作用を奏し、その共鳴による消音周波数は前記騒音の周波数に一致する。また、上記②の弁体は干渉管の途中部を開くため、干渉管は本来の干渉管に切り換わって干渉作用を奏し、その干渉による消音周波数は前記騒音の周波数に一致する。

【0015】このように、干渉管による消音作用を切り換えて消音周波数を騒音の周波数に一致させることにより、消音周波数範囲を効率的に広げることができる。また、その消音周波数範囲を広げるための構造を、前記の気圧調整手段、弁体及びばねという、簡単で、小さく、しかも少ない部品で構成することができる。

【0016】

【実施例】本発明を内燃機関の吸気管路に設ける共鳴型の消音装置に具体化した第一実施例について、図1～図5を参照して説明する。内燃機関のエアクリーナ1と燃料噴射装置2との間を結ぶ吸気管路としてのエアホース3の外部には、該エアホース3に両端において連通する干渉管4が設けられている。この干渉管4の両端間の実効長さをL1 とし、干渉管4の両端の開口部間の直線距離、すなわち干渉管4に対するエアホースの対応長さをL2 とすると、L1－L2 が半波長となる周波数で干渉が起こるから、この干渉の周波数すなわち消音周波数f0 は、次の数1で示される。

【0017】

【数1】f0 ＝C／［2（L1 －L2 ）］

ここで、C　＝331．5＋0．61t　：音速（m／秒）

t　：温度（℃）

【0018】エアホース3内に発生する吸気音の周波数fi は内燃機関の回転数に略比例して高くなるが、前記L1，L2 は一定であるから、消音周波数f0 を変化させるのは困難である。しかし、内燃機関の回転数が高くなったときに干渉管4の途中を閉じることができれば、この干渉管4は独立してエアホース3に連通する左右の第一サイドブランチ4a及び第二サイドブランチ4bとして共鳴するようになる。従って、両サイドブランチ4a，4bの各々の長さをL3，L4 とすると、消音周波数f0 は、次の数2で示される各サイドブランチ4a，4bの共鳴周波数すなわち消音周波数f01，f02の二種となる。よって、L3，L4 を適当に設定することにより、消音周波数f01，f02のいずれかを吸気音周波数fi と合わせることができる。

【0019】

【数2】f01＝（2n－1）C／4L3

f02＝（2n－1）C／4L4

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ここで、n　＝1，2，…

【0020】そこで、本実施例では、干渉管4の途中部に透孔51付の弁座5が設けられるとともに、干渉管4の両端間の気圧差が小さいうちは上に跳ね上がって前記弁座5の透孔51を開くが、干渉管4の両端間の気圧差が大きくなると下方に傾動して前記弁座の透孔51を閉じる板状の弁体6が設けられている。前記弁座5の直ぐ上流側の干渉管4の内壁には、弾性金属線を一回～数回小さく巻回してその両端を平行に延ばしてなるターン状ばね9がその一端において固定され、該ターン状ばね9の他端には前記弁体6がその背面において固定されている。よって、前記弁体6はターン状ばね9によりその巻回部を中心として傾動可能に支持され、傾動後はその傾動が復帰するようになっている。

【0021】また、干渉管4の左端の開口部であってその上流側の縁には、下流側へかつエアホース3の中心側へ向かって斜めに延びる気圧調整手段としてのベンチュリ片7が設けられている。このベンチュリ片7は、干渉管4の左端の開口部の負圧を右端の開口部の負圧より強めて、干渉管4の両端間に気圧差を発生させるためのものである。そして、内燃機関の回転数が高くなり、エアホース3内の気圧が低下して負圧が強くなると、前記干渉管4の両端間の気圧差も大きくなり、前述のように弁体6が変位して透孔51を閉じるようになっている。

【0022】次に、以上のように構成された消音装置の作用及び効果について説明する。まず、内燃機関の回転数が低いときには、吸気音周波数fi も低い。このときは、エアホース3内の負圧が弱く、干渉管4の両端間の気圧差も小さいため、図1及び図2に示すように、弁体6は上に跳ね上がったままほとんど傾動せず、透孔51は開いたままである。従って、干渉管4は本来の干渉作用を奏し、前出の数1により定まる消音周波数f0 は吸気音周波数fi に一致する。勿論、この一致は、前記干渉管4の実効長さL1 とエアホース3の対応長さL2 とが適切に設定されていることが前提となるが、その設定は前出の数1に基づいて容易に行うことができる。

【0023】次に、内燃機関の回転数が高くなると、吸気音周波数fi も高くなる。このときは、エアホース3内の負圧が強くなるとともに、ベンチュリ片7により干渉管4の左端の負圧が右端の負圧より強められて両端間の気圧差が大きくなるため、図3に示すように、弁体6は下方に傾動して弁座5に当接し、透孔51を閉じる。すると、この干渉管4は左右2本のサイドブランチ41，42として独立して共鳴するようになり、前記消音周波数f0 は前出の数2で示される消音周波数f01，f02に切り換わるため、それらのいずれか一方を吸気音周波数fi と一致させることができる。勿論、この一致は、両サイドブランチ41，42の長さL3，L4 が適切に設定されていることが前提となるが、その設定は前出の数2に基づいて容易に行うことができる。

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【００２４】ところで、内燃機関の吸気音周波数ｆｉは、一般に単一の周波数成分からなるものではなく、ピークレベルの周波数成分ｆｉ1とその他の周波数成分ｆｉ2とからなるものである。そこで、本実施例では、第一サイドブランチ４１による消音周波数ｆ01をピークレベルの周波数成分ｆｉ1に一致させ、第二サイドブランチ４２による消音周波数ｆ02をその他の周波数成分ｆｉ2に一致させることにより、消音効果をさらに高めるようにしている。

【００２５】このように、本実施例の消音装置によれば、このように、干渉管４による消音作用を切り換えて消音周波数ｆ０を吸気音周波数ｆｉに一致させることにより、消音周波数範囲を効率的に広げることができる。また、その消音周波数範囲を広げるための構造を、前記のベンチュリ片７、弁体６及びターン状ばね９という、簡単で、小さく、しかも少ない部品で構成することができるので、従来のこの種の消音装置に比べて構造が簡単かつ小型になり、コストアップを抑えることもできる。

【００２６】次に、図６～図８に示す第二実施例の消音装置について説明すると、この第二実施例は、①弁座５の下流側に設けられたばね端支持部１１と弁体６の背面との間にコイルばね１２を装着し、弁体６が弁座５に対して平行に対峙しながら変位するようにした点と、②干渉管４の右端の開口部であってその下流側の縁に、上流側へかつエアホース３の中心側へ向かって斜めに延びる気圧調整手段としての吸気取込片８を設けた点と、③もって、干渉管４の両端間の気圧差が小さいうちは弁体６が弁座５に当接して透孔５１を閉じ、干渉管４の両端間の気圧差が大きくなると弁体６が弁座５から離れて透孔５１を開くようにした点と、においてのみ第一実施例と相違している。前記吸気取込片８は、エアホース３内を流れる吸気の一部を干渉管４の右端から取り込んで該右端の気圧を左端より高めることにより、両端間に気圧差を発生させるためのものである。

【００２７】この第二実施例によれば、内燃機関の回転数が低いときには、図６及び図７に示すように、弁体６は弁座５に当接して透孔５１を閉じる。従って、干渉管４は第一サイドブランチ４１及び第二サイドブランチ４２として独立して共鳴するようになり、消音周波数ｆ０は前出の数２で示される消音周波数ｆ01，ｆ02となる。よって、Ｌ３，Ｌ４を適当に設定することにより、消音

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周波数ｆ01，ｆ02のいずれか一方を吸気音周波数ｆｉに一致させることができる。また、内燃機関の回転数が高くなると、図８に示すように、干渉管４の両端間の気圧差が大きくなり、弁体６はコイルばね１２の弾発力に抗して弁座５から離れて透孔５１を開く。従って、干渉管４は本来の干渉作用を奏し、消音周波数ｆ０は前出の数１により定まる周波数に切り換わる。よって、Ｌ１，Ｌ２を適当に設定することにより、消音周波数ｆ０を吸気音周波数ｆｉに一致させることができる。従って、この第二実施例も第一実施例と同様の効果を奏する。

【００２８】なお、本発明は前記実施例の構成に限定されず、発明の趣旨から逸脱しない範囲で任意に変更して具体化することもできる。

【００２９】

【発明の効果】本発明の消音装置は、上記の通り構成されているので、消音周波数範囲を広げることができるだけでなく、そのための構造が簡単かつ小型になり、コストアップを抑えることもできるという優れた効果を奏する。

【図面の簡単な説明】

【図１】第一実施例において干渉管の途中部が開いた状態の断面図である。

【図２】図１の要部断面図である。

【図３】第一実施例において干渉管の途中部が閉じた状態の要部断面図である。

【図４】図３の要部を右側から見た側面図である。

【図５】第一実施例の取付状態を示す正面図である。

【図６】第二実施例において干渉管の途中部が閉じた状態の断面図である。

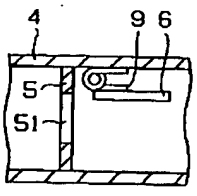
【図７】図６の要部断面図である。

【図８】第二実施例において干渉管の途中部が開いた状態の要部断面図である。

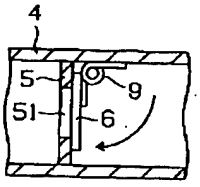
【符号の説明】

３　流気管路としてのエアホース　４　干渉管
６　弁体
７　気圧調整手段としてのベンチュリ片
８　気圧調整手段としての吸気取込片
９　ターン状ばね　　１２　コイルばね
４１　第一サイドブランチ　　４２　第二サイドブランチ

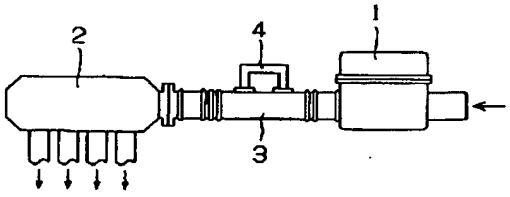
【図２】



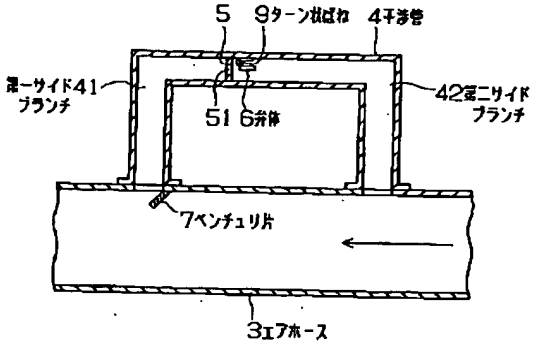
【図３】



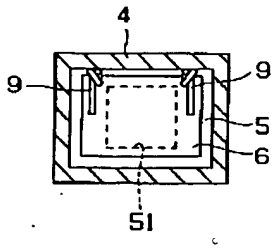
【図５】



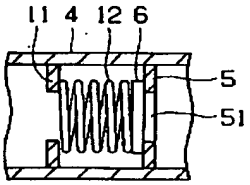
【図1】


5
9ターンばね
4干渉巻
第一サイド41
ブランチ
42第二サイド
ブランチ
51
6弁体
7ベンチュリ片
3エアホース

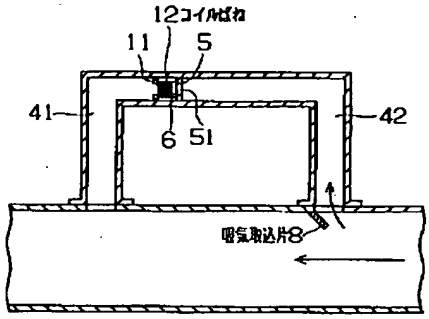
【図4】


4
9
9
5
6
51

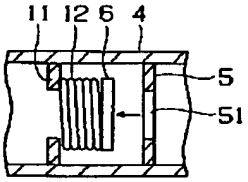
【図7】


11
4
12
6
5
51

【図6】


12コイルばね
11
5
41
42
6
51
吸気取込片8

【図8】


11
12
6
4
5
51

PAT-NO: JP404259617A

DOCUMENT-IDENTIFIER: JP 04259617 A

TITLE: MUFFLER DEVICE

PUBN-DATE: September 16, 1992

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APPL-NO: JP03039306

APPL-DATE: February 8, 1991

INT-CL (IPC): F01N001/06, F02M035/12

ABSTRACT:

PURPOSE: To provide a muffler device which is capable of widening a sound absorbing frequency range, having a simple and compact structure therefor and suppressing a manufacturing cost.

CONSTITUTION: An interference type muffler device has an interference pipe 4 whose both ends are communicated with an air hose 3. A pressure adjusting means 7 is provided on one or both end openings of the interference pipe 4 for generating pressure difference between both ends. A valve body 6 is arranged on the way of the interference pipe 4, for opening/closing the arrangement portion, which valve body 6 is displaced by means of the above-mentioned pressure difference. A spring 9, for resetting the displacement of the valve body 6, is also provided.